OAK RIDGE NATIONAL LABORATORY
MANAGED BY UT-BATTELLE FOR THE U.S. DEPARTMENT OF ENERGY

NORTHROP GRUMMAN

ESIP Energy Cluster:
Goals and Objectives

July 21, 2010

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Outline

- Climate Change Impact & Challenges
- Opportunities for Public and Private Sector
- ESIP Role
- Case Studies – California and New York City
- Energy Cluster Objectives and Agenda

Climate Change Impact on the U.S. Population, Infrastructure and Economy: User Needs

- Information needed for real world decisions involving a commitment of large resources in the near term that will have long term implications
- For adaptation and mitigation strategies, decision makers need
  - Access to the best available climate change data and scientific analysis (credible, robust, unbiased, and acceptable by science community)
  - Delivery of information tailored to the users' needs and practices
- Impact on energy supply and demand is one of the top priorities for stakeholders and end users (State/Local planners, Military Bases, Utilities)

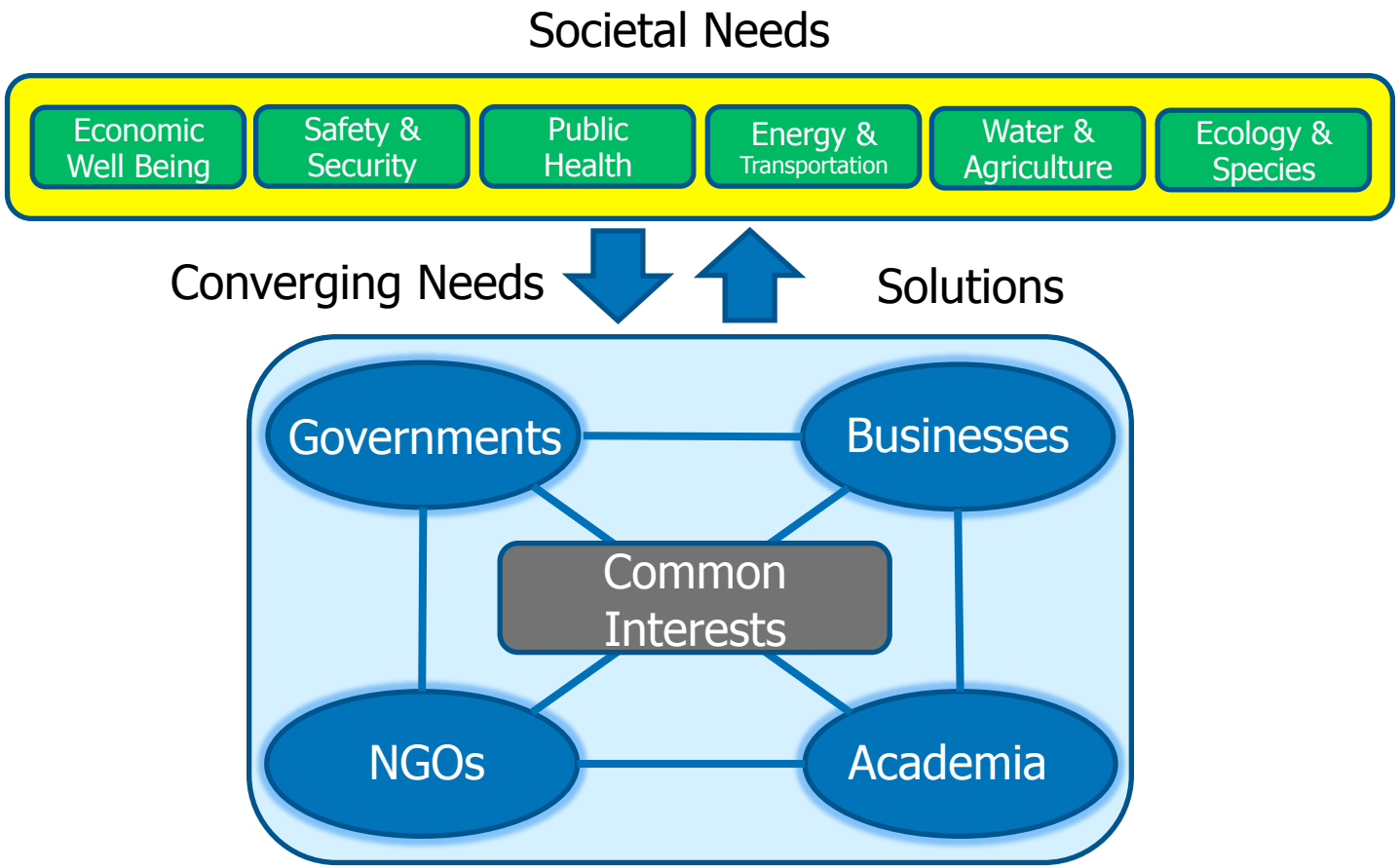
Conventional and Renewable Energy

Climate Change Information: Current State

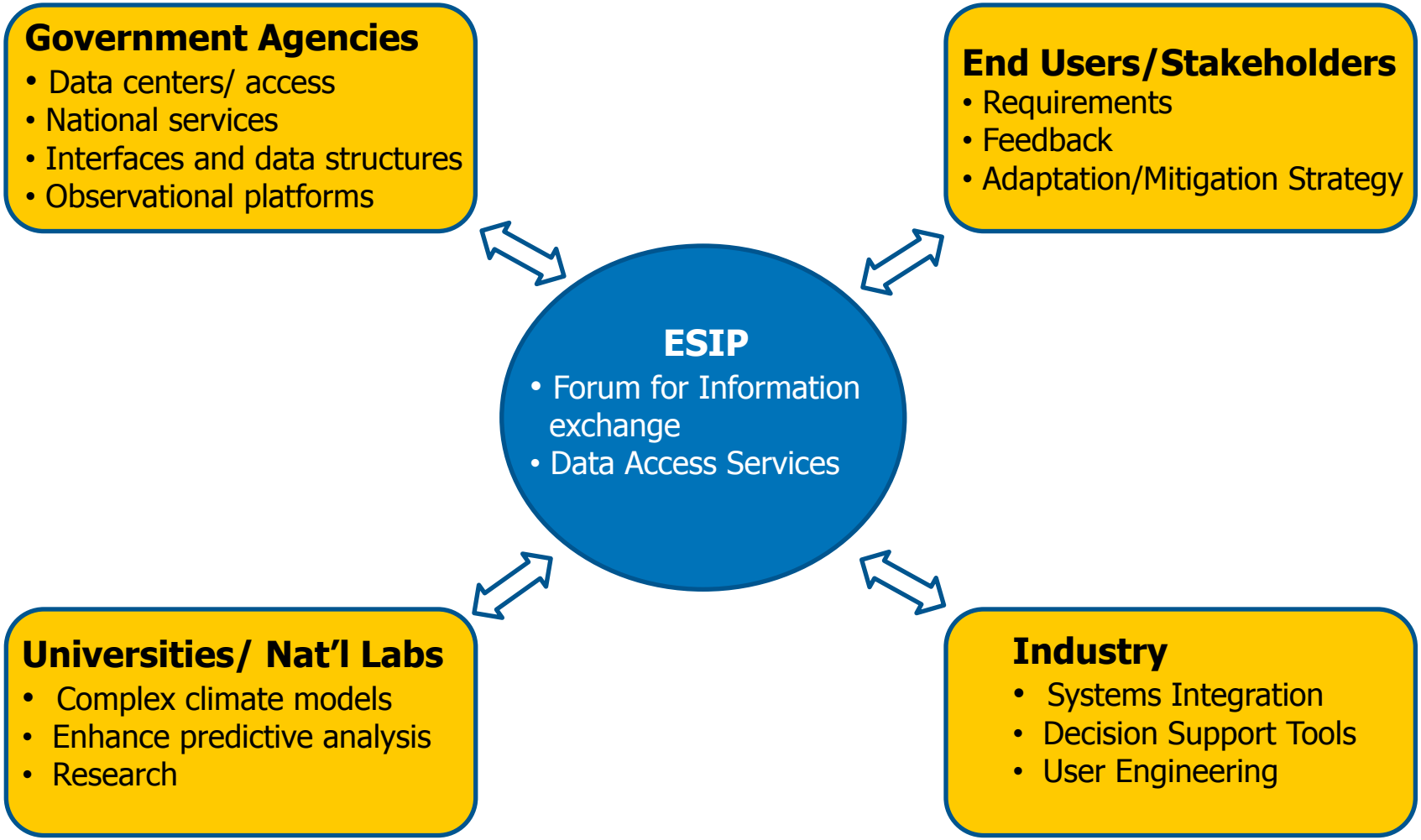
- Information Currently Available
  - Dispersed; Broad scale; Difficult to get; Not always consistent; Not actionable

A systematic approach is needed to provide actionable information to decision makers

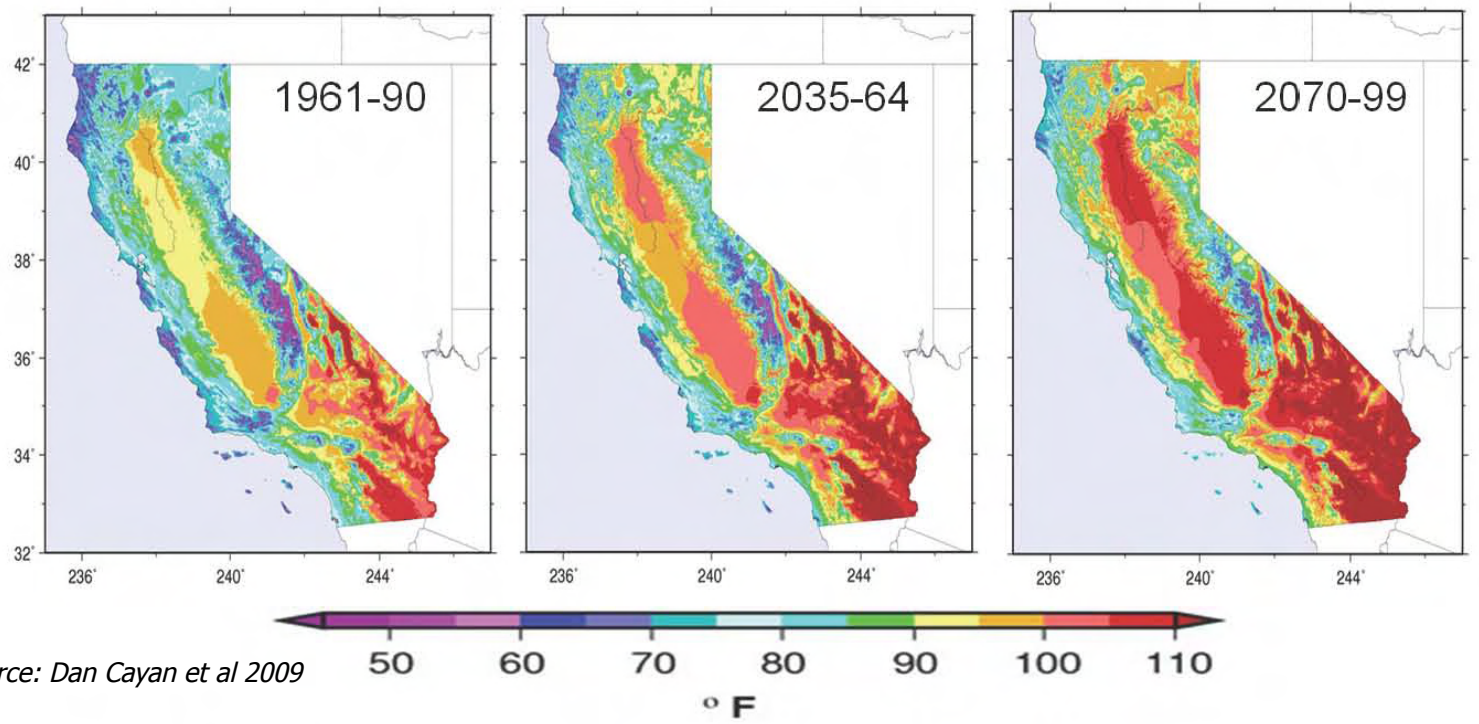
Public-Private Partnerships



Climate Change: Sector Roles & ESIP



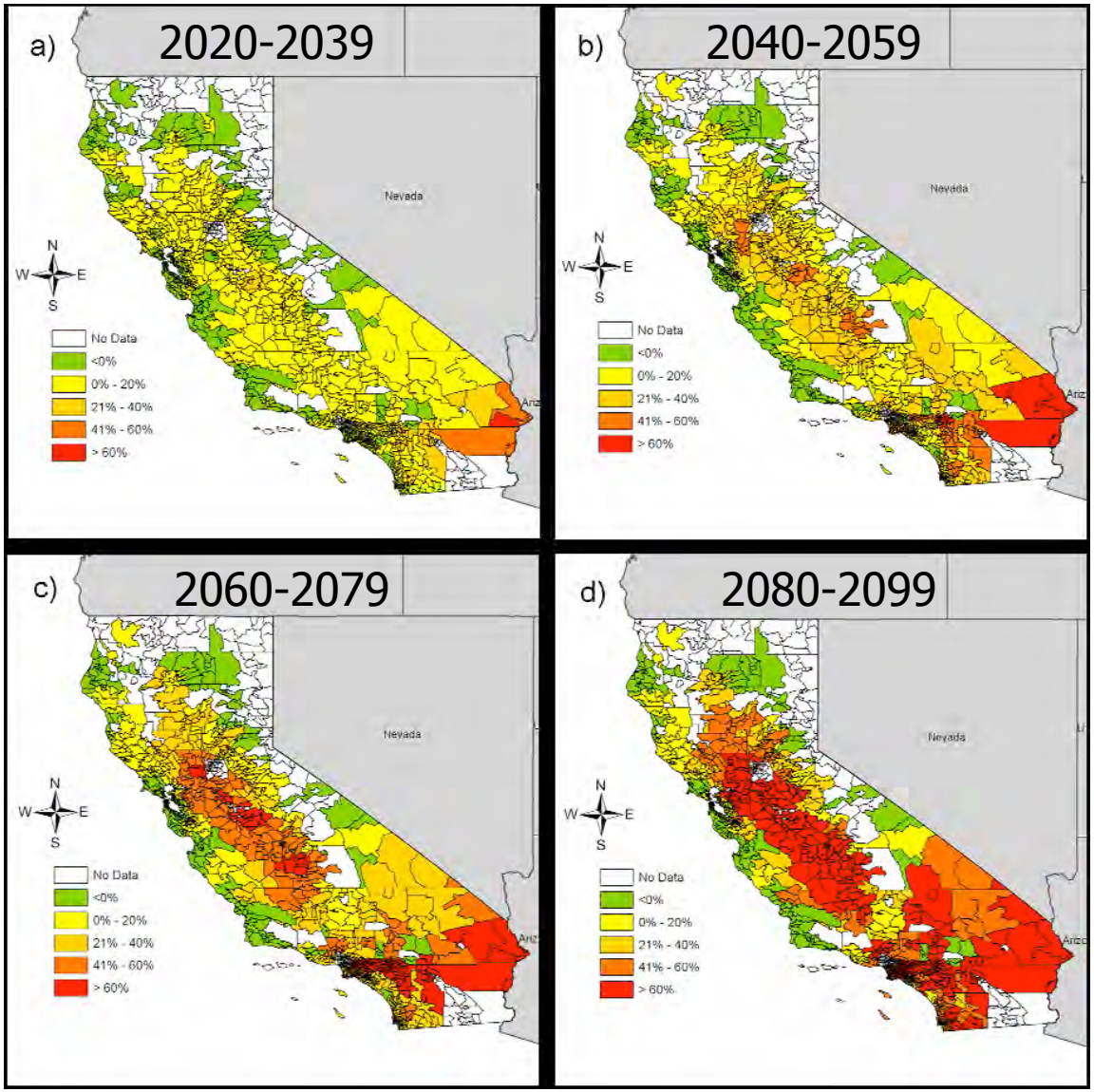
Climate Change Impact: Increased Temperatures California Historical and Projections



Source: Dan Cayan et al 2009

- Increased energy usage for cooling and air conditioning in Central Valley and Southern California
  - Can lead to electricity shortages and blackouts
- Limited energy availability for air conditioning and refrigeration/ Urban heat Islands
  - Heat stress causing morbidity and mortality
  - Increased risk of food-borne illnesses

California: Household use of Electricity



Source: Aroonruengsawat and Auffhammer, 2009

Climate Change Impact: More Frequent Extreme Events

- *In the next few decades*, it is likely that the world will face a growing number of climate change related extreme events

Wildfires

Heat Waves

Energy

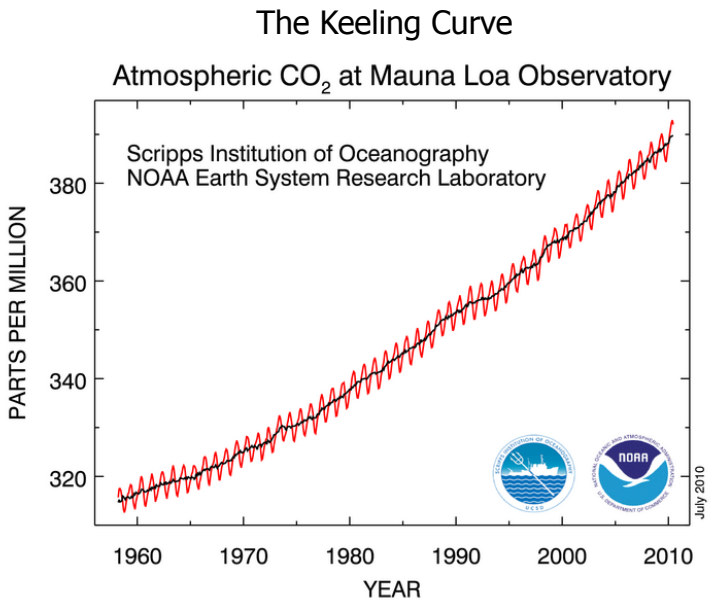
Drought

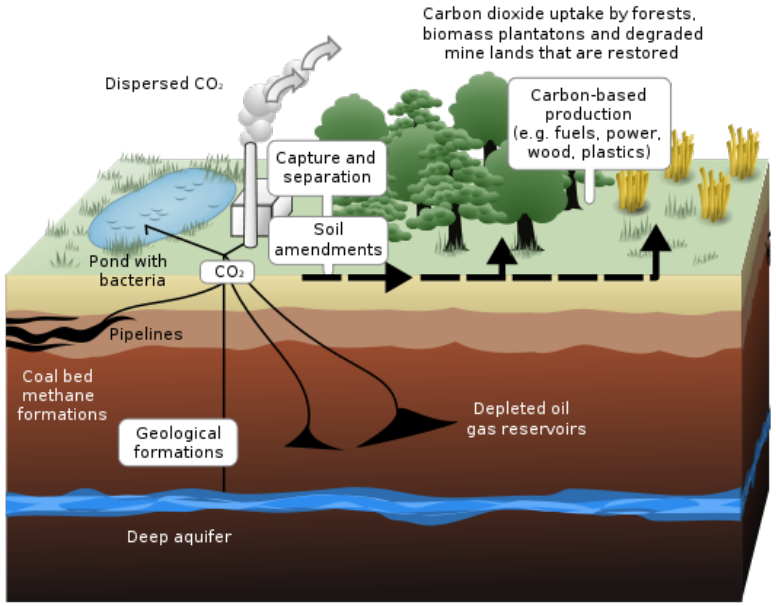
Floods

Energy infrastructure and other assets are at risk

CO2 Emissions and Carbon Sequestration

- 2009 California Climate Adaptation Strategy (CEC):
  - "Proper management of California's ecosystems, including forests, open spaces, and wetlands, may provide significant capture and sequestration of greenhouse gases while simultaneously providing habitats necessary for the long-term conservation of California's biodiversity."
  - "Carbon sequestration within large, vegetated floodplain corridors may also assist the state in meeting GHG emissions reductions mandated by AB32."



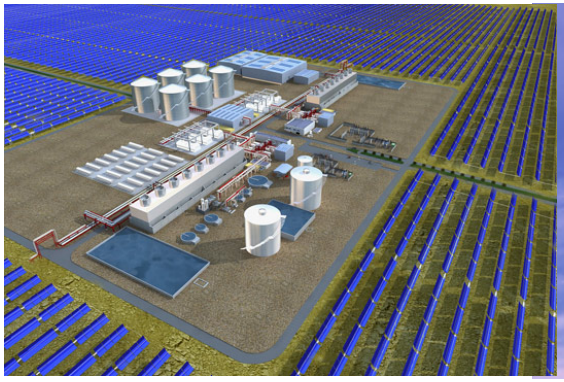


Source: Chris Hodrien *Claverton Energy Group Conference, Bath* (2008)

Renewable Energy Projections

- Climate change will influence wind, cloud and precipitation patterns
  - That will affect power levels from wind turbines, photovoltaics, and hydropower
  - Biomass feed-stocks could be reduced due to decreased water levels and increased wildfire.
- It is unclear how this will impact long-term projections for meeting renewable energy goals for the future.

Solar Power Plant



Wind Power Plant

Sugar-Ethanol Plant

California: Hydroelectric Power

- In 2007, nearly 12 percent of California's electricity from large hydroelectric power plants (CEC 2009)
- Climate Change Impact: Less water available during summer months
  - Snow falling at higher elevations, less snowpack
  - Melting earlier in the year
- Several dry years could create drought conditions
  - Reservoir levels lower than those required for hydroelectric power generation

Friant

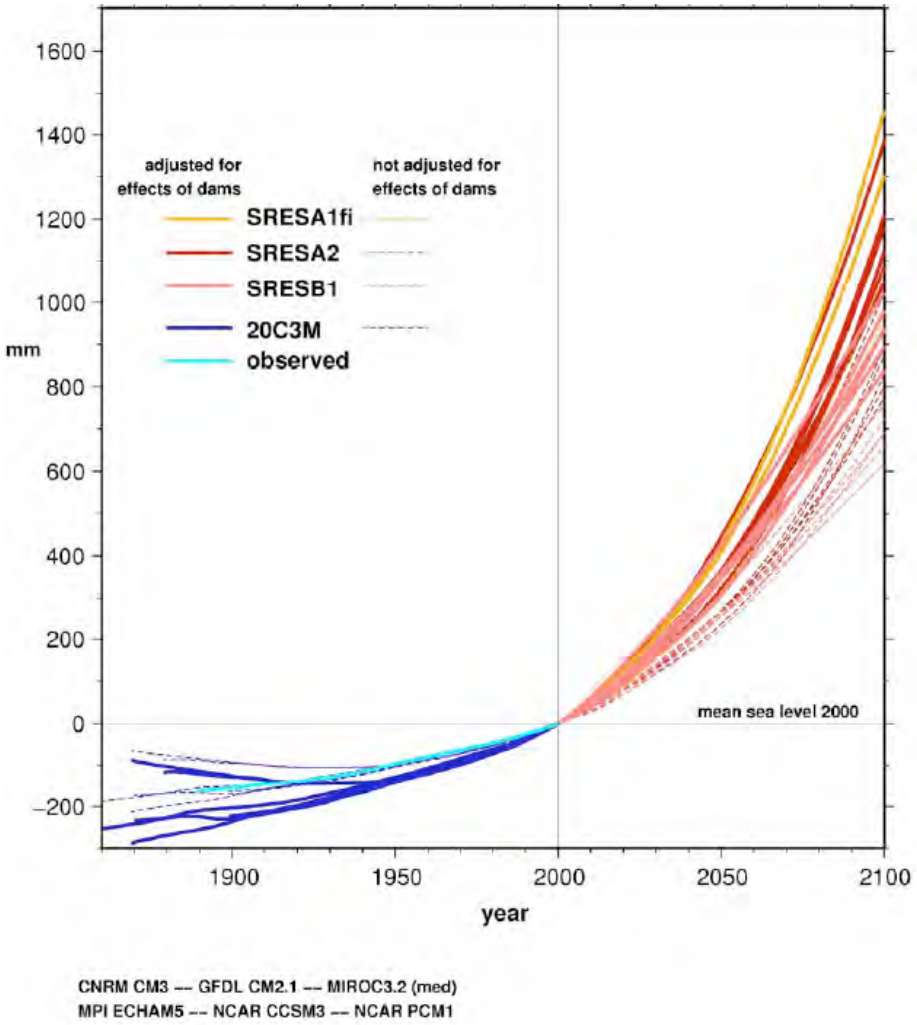
Shasta

Trinity

California: Sea Level Rise

- Energy Infrastructure in coastal areas will be impacted
- Over the 20th century, sea level has risen by about seven inches along the California coast
- Estimates of up to 55 inches (1.4 meters) of sea-level rise under the A2 emissions scenario by 2100
- Does not include ice melting from Greenland or the West Antarctic Ice Sheet

Source: Rahmstorf (2007) from six models 500-2009-014-D (i.e., Cayan, et al. 2009)



California Climate Adaptation Strategy (2009)*

Key Findings (Relating to Energy)

Climate change affecting California

- Higher temperatures and extreme weather events across the state,
- Reduced and shifting precipitation patterns in Northern California
- Sea-level rise

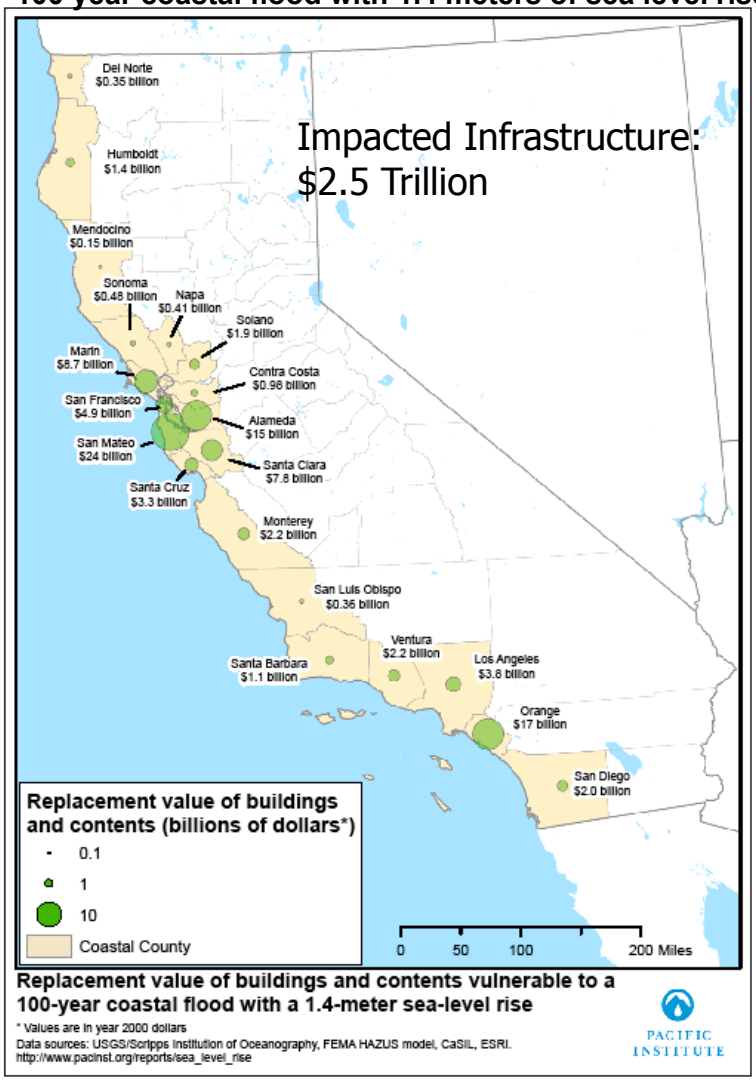
"The largest projected damages will come from sea-level rise threatening large portions of California's coastal transportation, housing, and energy-related infrastructure."

Preliminary Recommendations of California Energy Commission (Re: Energy)

- Greater energy conservation
- Increased use of renewable energy
- Provide tools, such as interactive climate impact maps, to assist local community planning entities
- Need for more coordination and guidance, funding, and outreach

*Source: www.climatechange.ca.gov/adaptation

Replacement value of buildings and contents vulnerable to a 100 year coastal flood with 1.4 meters of sea level rise



California coast has already risen up to seven inches over the last century

New York City Panel on Climate Change (2010)*

Key Findings (Relating to Energy)

New York City should begin to adapt to climate change today

- Proactive adaptation
  - Investments needed from both public and private sector

Climate change in NY poses serious & challenging risks

Heat and Heat Waves

- Warmer temperatures are extremely likely in New York City
- Heat waves are very likely to be more frequent, intense, and longer in duration
- Increased peak electric loads in summer
- More frequent blackouts, and
- Reduced heating requirements in winter

Sea Level Rise and Storm Surge

- Challenges to planning coastal waterfront development
- Enhanced flooding of low-lying neighborhoods and infrastructure (incl. power plants)
- Increased structural damage
- Impaired operations

*NPCC, Ann NY Acad Sci (2010), ISSN 0077-8923

Adaptation Approach (Energy Related)

Tools by a recognized body of experts that can help guide a wide group of stakeholders in "how to" address climate change

Establish a climate change monitoring program by creating

- a network of monitoring systems and organizations
- a region-wide indicator database for analysis

Power Plants in low lying neighborhoods

Quadrennial Defense Review (QDR) 2010*: Energy Related Requirements for Military Bases

1. The base shall complete a comprehensive assessment of potential impacts of climate change on its operations.
2. The base shall regularly reevaluate climate change risks and opportunities.
3. The base shall assess and reduce future energy demand.
4. The base shall determine future electrical demand characteristics.
5. The base shall determine current and projected energy production.
6. The base shall predict heating and cooling degree-days and projected extreme events of them along with other climate variables that will affect energy and water.
7. The base shall determine all potential renewable energy sources for that area to meet its projected demand and sustainability of operational readiness.
8. The base shall investigate alternative concepts for improving operation energy use, conservation measures, and the building of new infrastructure that meets LEED qualification levels.
9. The base shall conduct an energy assessment, prioritize critical assets in need of energy for operational readiness, and promote investments in energy efficiency.
10. The base shall act as a regional test bed for innovative energy efficiency and renewable energy technologies.

* The Quadrennial Defense Review Report QDR 29 January 2010; www.defense.gov/QDR

Power Grid

Energy strategies such as smart grid technologies aim to improve the ability of the electricity system to respond to peak demands.

"Almost complete dependence of military installations on a fragile and vulnerable commercial power grid and other critical national infrastructure places critical military and Homeland defense missions at an unacceptably high risk of extended disruption."

-Defense Science Board, February 2008

Information Gap (Assessments and Projections)

- Validated data
- Regional model downscaling to 4-12 km resolution
- Uncertainty quantification and risk analysis
- User interfaces and visualization tools
- Temperature/Precipitation Distribution and extreme events above thresholds
- Models/monitoring of greenhouse gas emissions
- Carbon sequestration options and analysis
- Power Grid vulnerabilities
- Renewable energy options and cost-benefit analysis
- Standards

Historical trends are not reasonable guides for the future

ESIP Energy Cluster: Goals

- Actively engage in understanding end user needs
- Provide a forum for
  - Policy discussion
  - Access to the best available data
  - Access to world-class climate change science
  - Solutions focused on implementable actions
- Foster collaboration among government agencies, private sector, NGOs, and academia

Help in building a climate-resilient society

ESIP Energy Cluster:
Wednesday Afternoon July 21, 2010

End User Needs and Policy Perspective

1:15 - 1:45 Intro to Energy Cluster: Goals and objectives (Shailendra Kumar, NGC)

1:45 - 2:15 Policy and Impacts perspectives on Energy and Climate Change
(Ben Preston, ORNL)

2:15 - 2:45 Initiating Sustainability in the City of Knoxville: Progress and Needs
(Erin Burns, City of Knoxville)

2:40 - 3:10 Break

3:15 - 3:45 NASA Products to enhance Energy Load Forecasting (Erica Zell, Battelle)

3:45 - 4:15 SmartGrid Energy Usage (Scott Crowder, NREL)

4:15 - 4:45 Panel discussion on end user needs and policy perspective (all)

5:00 - 7:00 Poster session and reception (plenary)

ESIP Energy Cluster: Thursday Morning July 22, 2010

Data Providers

8:30 - 9:00 Solar and Wind Energy Assessment, Prediction, and Projection (Mark Liu, NOAA)

9:00 - 9:30 NASA Research Datasets for the Renewable Energy Sector (Paul Stackhouse, NASA)

9:30 - 10:00 CO2 Emissions Estimates/Forecasts (Tom Boden, ORNL)

10:00 - 10:30 VERDE -- Visualizing Energy Resources Dynamically on the Earth (Arjun Shankar, ORNL)

10:30 - 11:00 Break

11:00 - 11:35 National Hydropower Asset Assessment Program (Bo Hadjerioua, ORNL)

11:35 - 12:15 Wind Energy resources and outreach (Dale Kaiser, ORNL)

12:30 - 1:30 lunch

ESIP Energy Cluster:
Thursday Afternoon July 22, 2010

Data Providers and Decision Support Solutions

1:30 - 2:00 Data generated and needed for carbon sequestration (Jeff Bielicki, ORNL/UT)

2:00 - 2:30 Downscaling models for regional and local Applications (Glenn Higgins, NGC)

2:30 - 3:00 IEEE SCC40 activities for Electric Sourced Transportation Infrastructure Standards (Siri Jodha Singh Khalsa, NSIDC, via WebEx)

3:00 - 3:30 break

3:30 - 4:00 Energy metadata standards (energetics.org) and geothermal information management (Wolfgang Grunberg, Arizona Geologists Office, via WebEx)

4:00 - 5:00 Open discussion of Energy cluster future and plans